CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-51

May 31, 1978

1. Name of fault

Santa Monica fault. (In part it has been called the Hollywood fault.)

2. Location of fault

This fault lies along the southern side of the Santa Monica Mountains, Los Angeles County, California (figure 1).

3. Reason for evaluation

This fault is located within the 1977 study area of the 10-year program for fault evaluation.

4. List of references

Bulka, J.A., and Teng, Ta-Liang, 1978, Recent seismicity and fault-plane solutions of the Santa Monica Mountains, Santa Monica Bay, and northern Los Angeles Basin: Geologic guide and engineering geology case histories, Los Angeles metropolitan area, Association of Engineering Geologists first annual California section conference, Los Angeles, p. 64-72.

(Their map shows relatively little seismicity associated with the Santa Monica fault, 1973-1976.)

Eschner, S., and Scribner, M.K., 1972, The discovery and development of the Sawtelle field: Technical Program Preprints, Pacific Sections of AAPG --SEG Forty-seventh Annual Meeting, Bakersfield, California, 5 p.

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Hill, R.L., E.C. Sprotte, J.H. Bennett, R.H. Chapman, C.W. Chase, C.R. Real, and Glenn Borchardt, 1977, Santa Monica-Raymond Hill fault zone study, Los Angeles County, California: California Division of Mines and Geology, Final Technical Report (Annual Technical Report for Fiscal Year 1976-77) to the U.S. Geological Survey, National Earthquake Hazards Reduction Program Contract No. 14-08-0001-15858. C.H. Gray, Jr., Principal Investigator.

(This reference gives the most useful discussion on recency of activity and surface expression of the Santa Monica fault.)

Hill, R.L., Slade, R.C., Sprotte, E.C., and Bennett, J.H., 1978, Fault location and fault activity assessment by analysis of historic leveling data, oil well data and ground water data, Beverly Hills-Hollywood area, California: Geologic guide and engineering geology case histories, Los Angeles metropolitan area, Association of Engineering Geologists first annual California section conference, Los Angeles, p. 167-174.

Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs and thermal wells: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1, scale 1:750,000.

Lamar, D.L., 1970, Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California: California Division of Mines and Geology Special Report 101, 45 p., 2 plates. Map scale 1:24,000.

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5. Summary of available data

The Santa Monica fault (or fault zone) forms the structural boundary between the western Transverse Ranges and the Los Angeles Basin. Along the fault, upper Mesozoic granitic basement rock of the Santa Monica Mountains has been thrust or reverse faulted southward over upper Tertiary strata of the Los Angeles Basin. To the west, beyond Santa Monica, the fault is known as the Malibu fault. East of the Los Angeles River, the Raymond Hill fault is thought to be the eastward continuation of the Santa Monica fault.

Because of oil production immediately to the south of the fault in several places, the existence and character of the fault in the subsurface are well known. Hill and others (1978) have made heavy use of oil and water well data to determine the subsurface character of the fault in the Beverly Hills-Hollywood area. Farther to the west, in the Westwood area, Eschner and Scribner (1972) discuss the subsurface character of the Santa Monica fault and its relationship to the structure of the Sawtelle oil field. None of the workers, however, have mapped the Santa Monica fault at the surface, except, possibly, at the extreme eastern end of the fault. There, immediately west of the Los Angeles River, Lamar (1970, plate 1) shows two parallel east-northeast-trending short fault segments (figure 2 of this FER)which Hill (personal communication, 5/22/78) says may represent the surface expression of the extreme eastern end of the Santa Monica fault zone. In the Beverly Hills-Hollywood area, Hill and others (1977, figure 2) have inferred the near-surface traces of the fault (figure 3 of this FER). To the west of Beverly Hills, there are no surface maps of the fault known to the writer.

No evidence for Holocene offset along the Santa Monica fault is presented in any of the references. Hill and others (1977, p. 4-7) give a good discussion of the question of recency of movement along the fault. This part of their report is reproduced in Appendix A of this FER. Also, the bibliography given by Hill and others (1977 and 1978) is reproduced in Appendix B of this FER.

No historical earthquakes have been associated with the Santa Monica fault. Figures 4a and 4b show the seismicity of this region between 1900 and 1974 (Real and others, 1977). These maps show the fault, and the Santa Monica Mountains to the north, to be a relatively aseismic area. There is some clustering of epicenters at the eastern end of the fault, but these events, as shown on figures 4b, suggest a northwest-trending causative fault. Buika and Teng (1978) studied the seismicity of this area during the period 1973 to 1976. Figure 5 is a reproduction of their epicenter and magnitude plot map. Again, there is little seismicity associated with the Santa Monica fault except for a slight clustering near the eastern end.

6. Interpretation of aerial photos: None.

7. Field observations: None.

8. Conclusions:

The Santa Monica fault is very poorly defined and, for the most part, has not been defined at the surface. There is no specific evidence to indicate that there has been Holocene activity along the fault. The lack of surface expression tends to suggest that the fault has not been active during Holocene time.

9. Recommendations;

I do not recommend any zoning along the Santa Monica fault.

10. Investigating geologist's name and occupation;

Drew P. Smith

DREW P. SMITH
Assistant Geologist
May 31, 1978

I agree with recommendation.
Elliott
6/2/78

APPENDIX A

A Reproduction of the Discussion of the Santa Monica Fault by Hill and others (1977, p. 4-7).

At present, no conclusive evidence of Holocene surface rupture has been found onshore west of the Raymond Hill segment of the Santa Monica-Raymond Hill fault zone. All of the known faults in the Santa Monica-Raymond Hill fault zone in the area between Santa Monica Bay and the Los Angeles River show evidence of Pleistocene movement but geologic conditions, coupled with obliteration and modification of geomorphic features by intense urban development in this area, are such that the possibility of Holocene surface rupture cannot be excluded on the basis of this investigation. Work by the USGS indicates that Pleistocene and possibly basal Holocene sediments are offset or warped along offshore faults in the Santa Monica fault zone in Santa Monica Bay.

West of the junction of the Santa Monica-Raymond Hill and Newport-Inglewood fault zones there are at least two major subparallel faults transecting the Santa Monica-West Los Angeles area. Subsurface control on the southern fault is provided by oil well data. Projection of the fault plane to the surface indicates that it is associated with a ground water barrier in Pleistocene sediments. A topographic scarp in Pleistocene sediments underlying the Santa Monica area is aligned with the westerly projection of the ground water barrier.

The northern fault appears to be the eastward extension of the Potrero Canyon and Malibu Coast faults. Local control on the deep subsurface location and configuration of this fault is provided by data from oil wells in the vicinity of Beverly Hills. Geomorphic features including topographic scarps in Pleistocene terrace deposits are evident locally along the northern fault. The continuity of the northern fault is uncertain but one interpretation that appears reasonable at this time is that this fault extends from the mouth of Potrero Canyon near the coastline northwest of Santa Monica eastward across the Hollywood area to the Los Angeles River. If so, this fault may be a continuation of the southern fault in the Beverly Hills-Hollywood area east of the junction of the Santa Monica-Raymond Hill and Newport-Inglewood fault zones.

East of the junction of the Santa Monica-Raymond Hill and Newport-Inglewood fault zones there are at least two major faults transecting the Beverly Hills-Hollywood area. The northern fault, which generally follows along the base of the Santa Monica Mountains front, is not well located except where it was intersected by a sewer tunnel. This fault is probably a composite of more than one fault forming a fault zone along the front of the mountains. Geomorphic features along the fault are indicative of Late Quaternary movement.

The results of analysis of precision leveling data, oil well data, and ground water data by CDMG, by Erickson and Spaulding (1975) and by Geotechnical Consultants, Inc. (1975) indicate that the near-surface trace of the southern fault in the Beverly Hills-Hollywood area may be located within a zone of differential subsidence that varies from about 100 m to 400 m (300 to 1,300 feet) wide depending on the density of survey stations and on the resolution of data from repeated leveling surveys. These data also suggest that the fault forms a ground water

barrier that extends upward at least into the lower part of the Pleistocene fresh-water bearing deposits.

Gravity surveys indicate that the Santa Monica-Raymond Hill fault zone is associated with a zone of southward sloping steep gravity gradients. Others have proposed that, in the area of the Los Angeles River, the Santa Monica-Raymond Hill fault zone has been offset laterally along northwest trending faults along the northwesterly projected trend of the Whittier fault zone. The gravity data are not conclusive of either continuity or offset of the Santa Monica-Raymond Hill fault zone in this area, but if offset has occurred, the data limit the amount of possible offset to about 457 m (1,500 feet).

The U.S. Geological Survey aeromagnetic survey of the Los Angeles basin was flown at a flight elevation of 500 feet and a line spacing of about one mile.

West of the Los Angeles River, the magnetic field is characterized by numerous small anomalies of limited areal extent with predominantly west or northwest trends. Positive anomalies with amplitudes of less than 100 gammas are clearly associated with exposed Miocene volcanic rocks in the Santa Monica Mountains, but anomalies do not appear to be related to the exposed granitic and metamorphic rocks in this area. The causes of the small anomalies south of the Santa Monica Mountains in the Los Angeles basin are not known, but many appear to be associated with man made features such as oil fields, railroad yards, and industrial areas. Judging from the size and area extent of these anomalies, they have relatively near-surface causes and are not related to basement rocks. There is no evidence in the magnetic data of the presence of the Santa Monica fault zone or other possible faults along the southern margin of the Santa Monica Mountains west of the Los Angeles River.

APPENDIX B

Reproductions of the Bibliographies of Hill and others (1977 and 1978).

Hill et al Refs (1977)

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Andreasen, G.E., J.A. Pitkin, and F.A. Petrafeso. 1964b. Aeromagnetic map of eastern Los Angeles and vicinity, California: U.S. Geological Survey, Geophysical Investigations Map GP-465.

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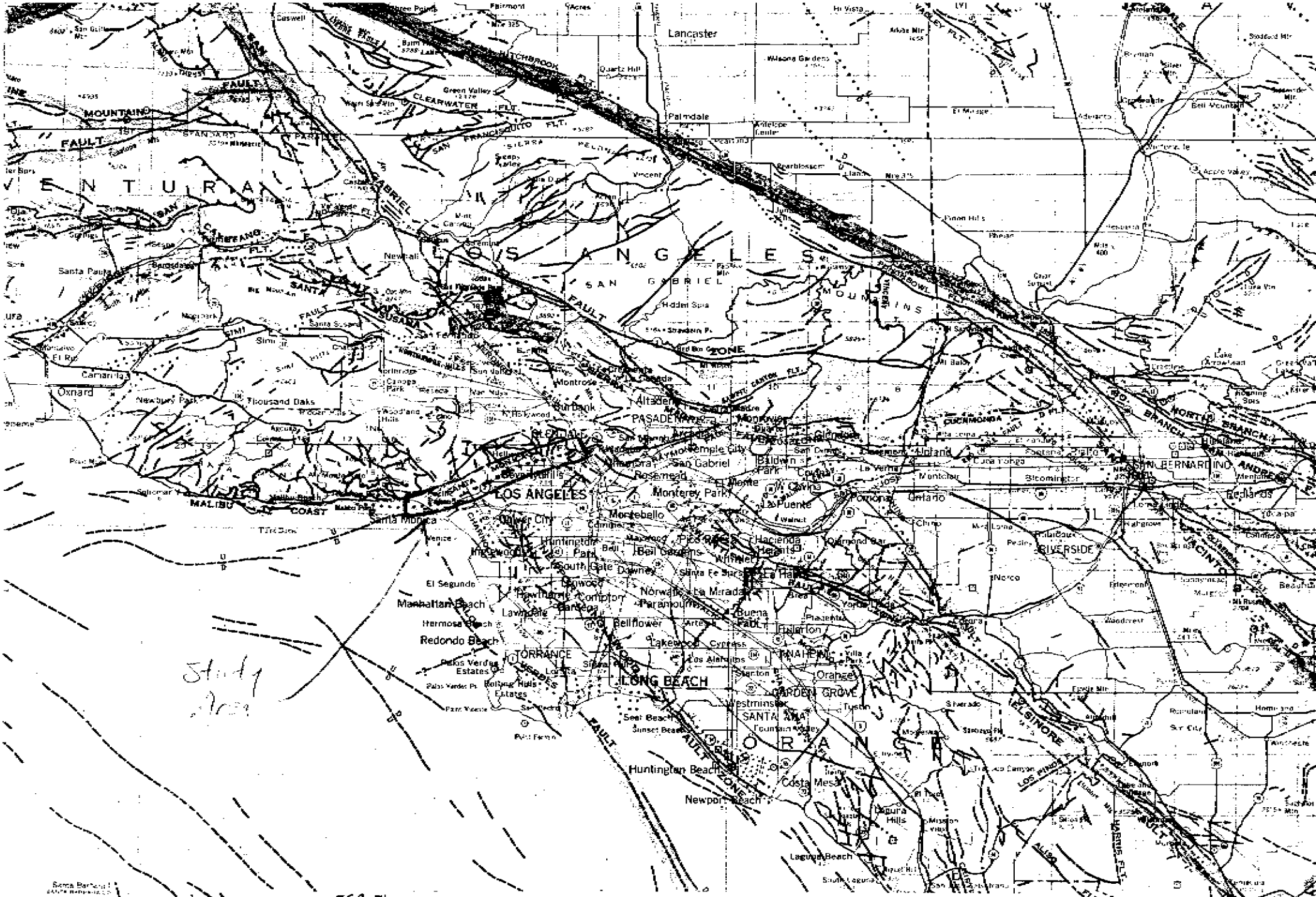

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Figure 1. Index map showing the location of the Santa Monica fault.

Map is modified from Jennings (1975).

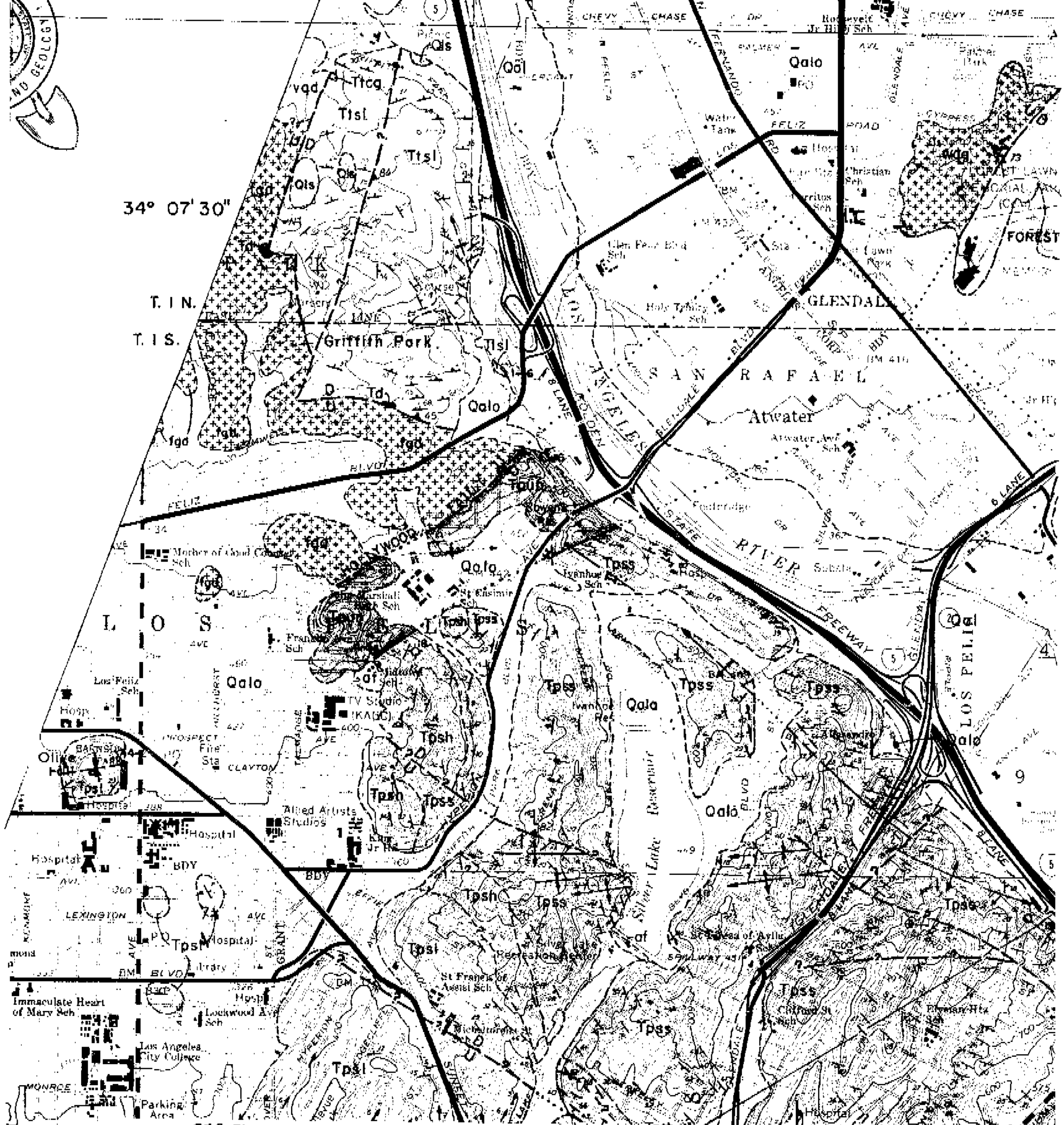

Figure 2. A reproduction of the northwestern part of the map of Lamar (1970, plate 1) showing two parallel east-northeast-trending short fault segments which may represent the eastern end of the Santa Monica fault zone.

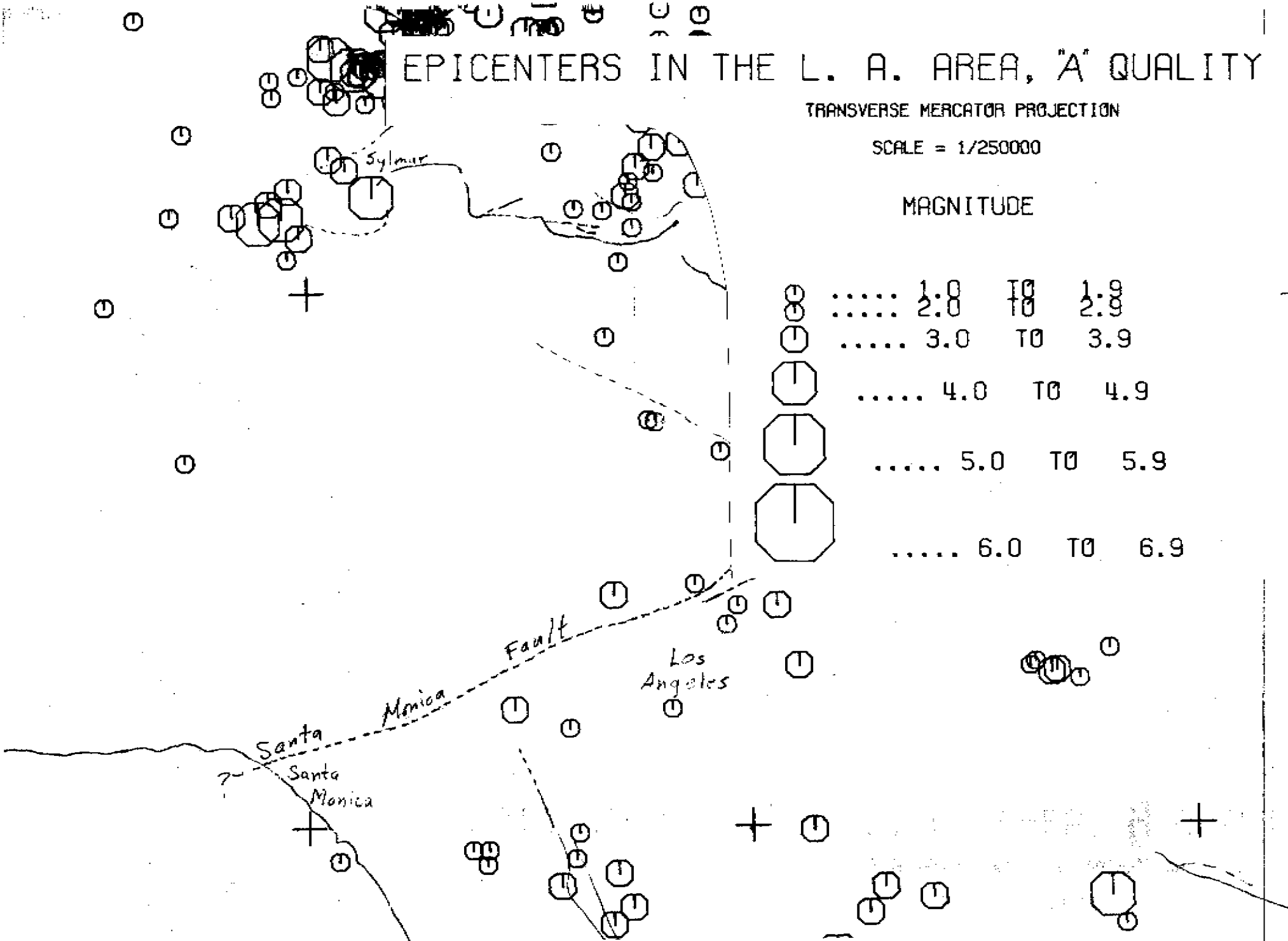

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Figure 4a. Seismicity in the vicinity of the Santa Monica fault. "A" quality epicenter plots from Real and others (1977).

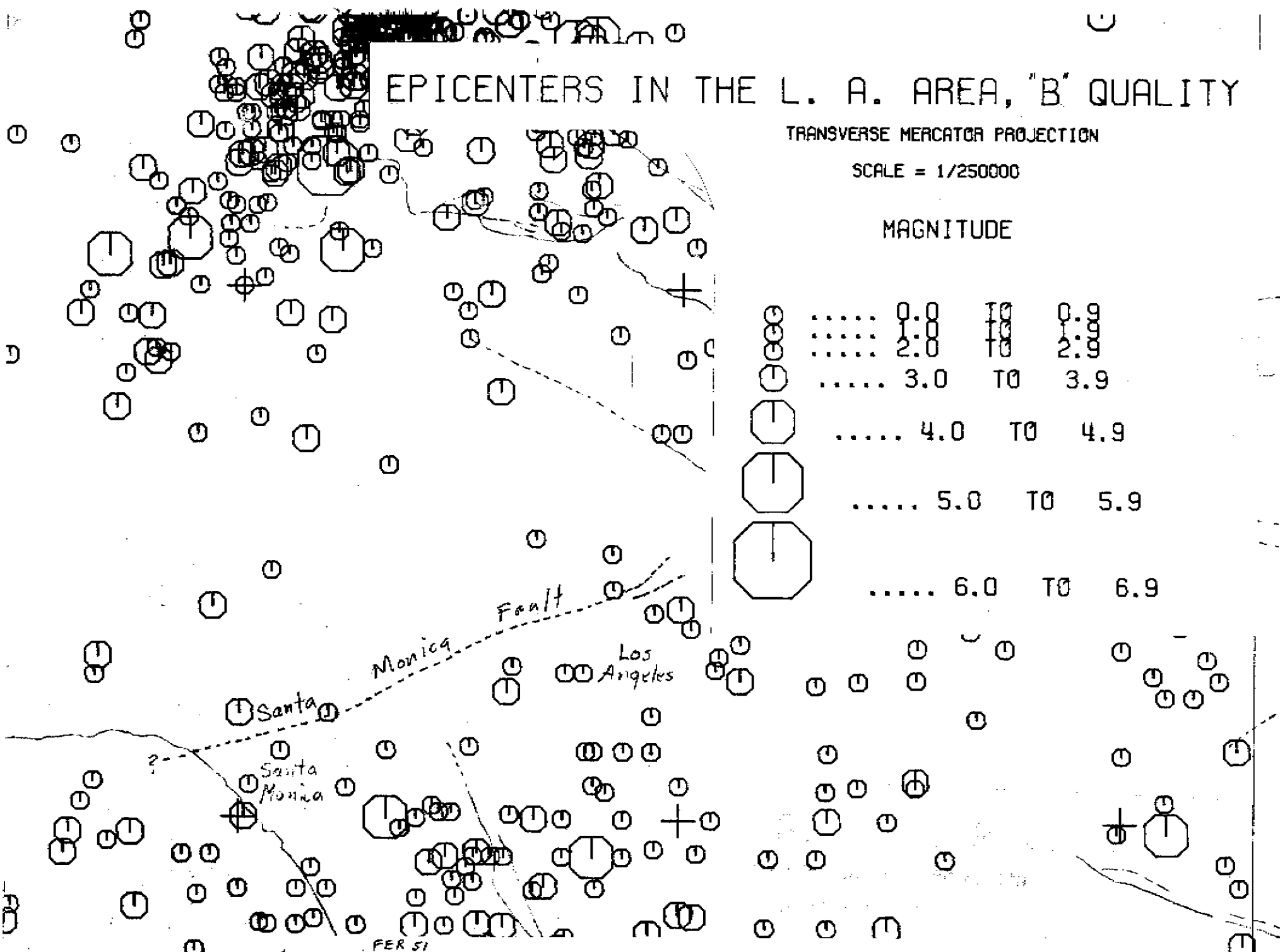

Figure 4b. Seismicity in the vicinity of the Santa Monica fault. "B" quality epicenter plots from Real and others (1977).

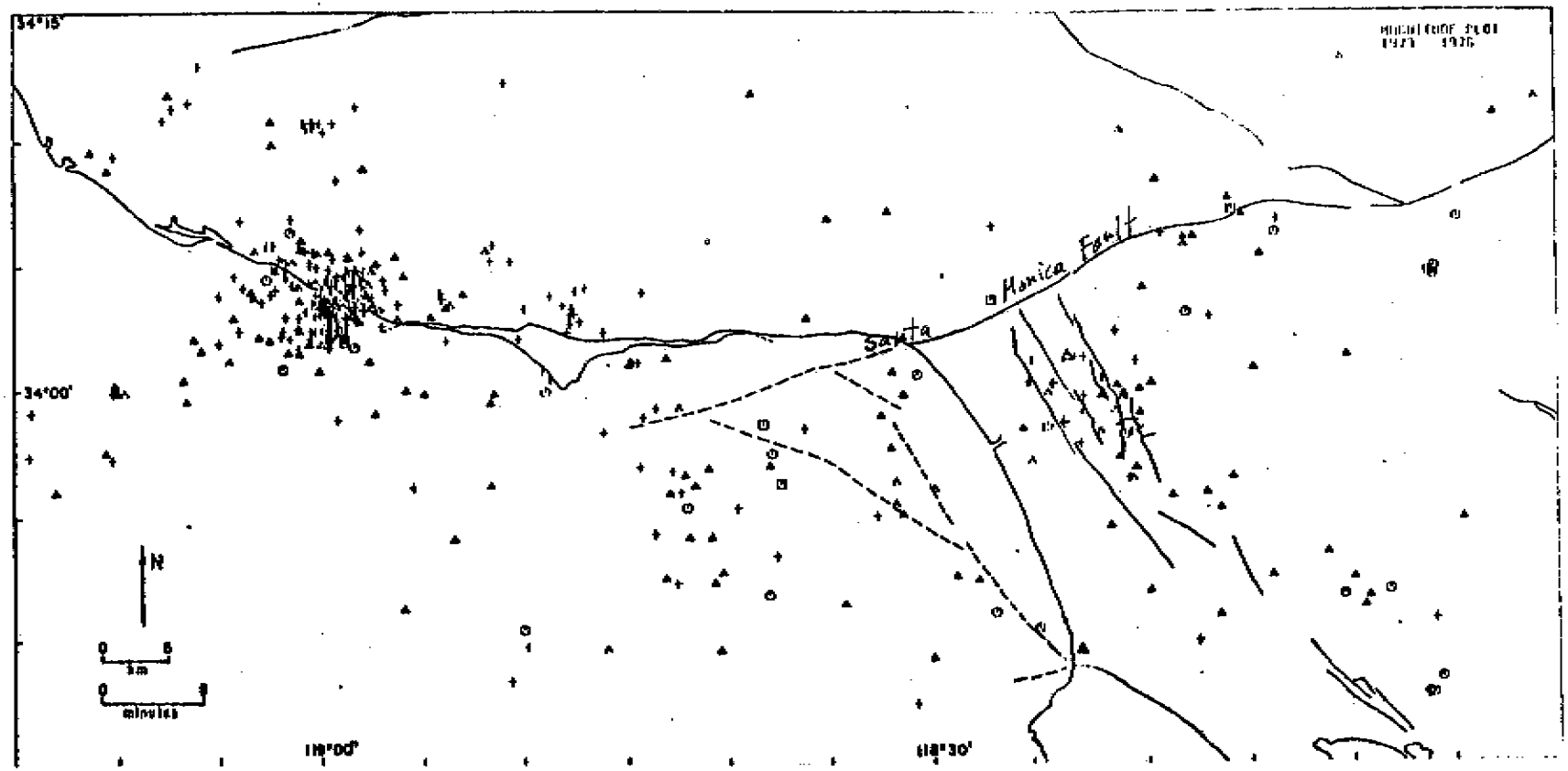

Figure 2. Epicenter and magnitude plot of 1973 - 1976 earthquakes. Only major faults outlined.

Legend:
- ✱ - M≥5.0
- □ - M≥4.0
- O - M≥3.0
- △ - M≥2.0
- \+ - M>1.0

Figure 5. A reproduction of Figure 2 of Bujka and Teng (1978).

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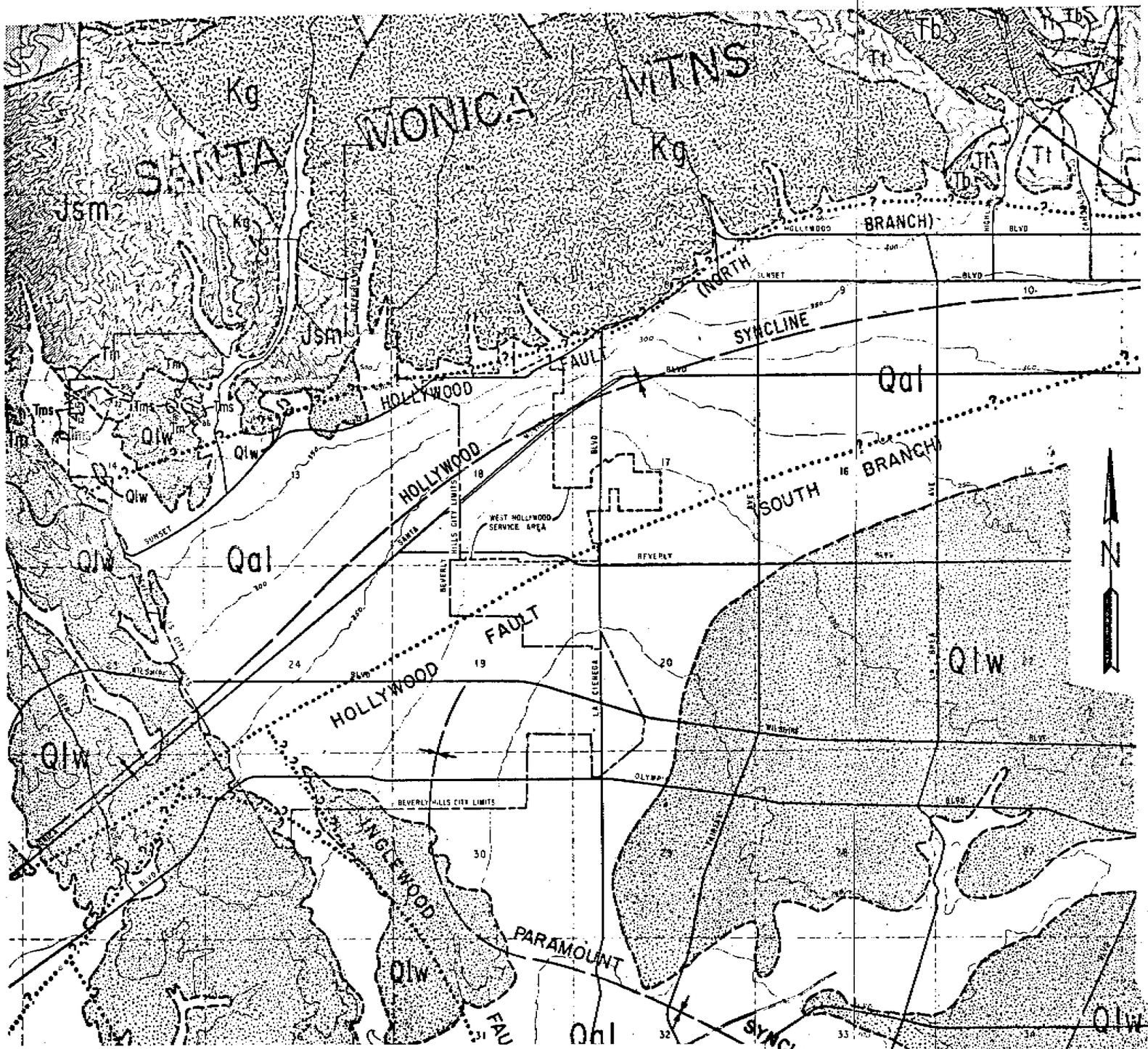

GEOLOGIC MAP OF BEVERLY HILLS-HOLLYWOOD AREA
LOS ANGELES COUNTY, CALIFORNIA

EXPLANATION

- Qal — HOLOCENE ALLUVIUM: Silt, Sand & Gravel
- Qlw — UPPER PLEISTOCENE LAKEWOOD FM.: Continental & Marine Clay, Silt, Sand & Gravel
- Tm / Tms — UPPER MIOCENE MODELO FM.: Marine Siliceous & Non-siliceous Shale with Sandstone Lenses (Tms)
- Tt / Tb — MIDDLE MIOCENE TOPANGA FM.: Marine Gonglomerate, Sandstone, Shale & Basalt (Tb)
- Kg — CRETACEOUS GRANITIC ROCK
- Jsm — JURASSIC SANTA MONICA SLATE
- GEOLOGIC CONTACT
- FAULT: Dotted where Buried; Queried where Poorly Located
- AXIS of SYNCLINE

0 1 MILE
0 4000 FEET
0 1 KILOMETER

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Figure 3. A reproduction of Figure 2 of Hill (1977) showing his inferred near-surface traces of the Santa Monica fault.

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